

1 **Amendment to the Claims**

2 **In the Claims:**

3 Please cancel Claims 3, 4, 17, 18, 29, 30, 82, 88, 93, and 100-110.

4 Please amend Claims 1, 5, 7, 13, 19, 21-28, 31-34, 48, 56, 76, 79, 80, 83, 84, 89, and 94 as
5 noted below.

6 Please add new Claims 111-123 as noted below.

7 1. (Currently Amended) A stacked plate reactor for reacting one chemical reactant with at least one
8 other chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of
9 simple plates, stacked in layers, each simple plate having at least one opening that extends therethrough, an
10 opening in each simple plate overlapping at least one other opening in an adjacent simple plate, said simple
11 plates, when thus stacked in layers, defining:

12 (a) a fluid path for each different chemical reactant;
13 (b) a fluid path for a chemical product; and
14 (c) ~~a fluid path for a heat transfer medium;~~
15 ~~a heat exchanger coupled in fluid communication with the fluid path for the~~
16 ~~heat transfer medium; and~~

17 (d) ~~means for manipulating a flow of fluid in said stacked plate reactor to achieve~~
18 ~~a desired result~~

19 (e) a plurality of individual reaction units providing internal parallelization of fluid
20 flow through the stacked plate reactor, thereby increasing a quantity of chemical product that can be
21 produced by said stacked plate reactor per unit time, each reaction unit including:

22 (i) a mixing and reaction chamber;
23 (ii) a reactant fluid path for each reactant, each reactant fluid path being in fluid
24 communication with said mixing and reaction chamber; and

25 (iii) a bypass fluid path for each reactant, each bypass fluid path being in fluid
26 communication with a different individual reaction unit, such that a reactant flowing in a bypass fluid path
27 in a reaction unit does not also flow into a mixing and reaction chamber in said reaction unit.

28 2. (Original) The stacked plate reactor of Claim 1, further comprising at least one additional plate
29 having no openings, said at least one additional plate being disposed to seal at least one of a top, a bottom,
30 and a side of the stacked plate reactor

31 3. (Currently Cancelled)

32 4. (Currently Cancelled)

33 5. (Currently Amended) The stacked plate reactor of ~~Claim 4~~ Claim 1, wherein a plurality of
individual reaction units are irreversibly joined together to form a reactor stack.

1 6. (Original) The stacked plate reactor of Claim 5, wherein a plurality of individual reactor stacks
2 are reversibly joined together to form a chemical plant.

3 7. (Currently Amended) The stacked plate reactor of Claim 1, ~~wherein said means for~~
4 ~~manipulating a flow of fluid comprises~~ further comprising means for equalizing a residence time
5 distribution within said stacked plate reactor.

6 8. (Original) The stacked plate reactor of Claim 7, wherein said means for equalizing the residence
7 time distribution within said stacked plate reactor comprises a bifurcated opening in at least one of the
8 plurality of simple plates, said bifurcated opening defining at least one of a reactant fluid path and a product
9 fluid path.

10 9. (Original) The stacked plate reactor of Claim 7, wherein said means for equalizing a residence
11 time distribution within said stacked plate reactor comprises an array of openings in at least one of the
12 plurality of simple plates, said array of openings defining at least one of a plurality of reactant fluid paths, a
13 plurality of mixing and reaction chambers, and a plurality of product fluid paths, said array of openings
14 comprising openings having widths that vary across said array.

15 10. (Original) The stacked plate reactor of Claim 9, wherein a widest opening in said array is
16 disposed furthest from an opening that enables a fluid to exit from said array.

17 11. (Original) The stacked plate reactor of Claim 9, wherein a widest opening in said array is
18 disposed closest to an opening that enables a fluid to exit from said array.

19 12. (Original) The stacked plate reactor of Claim 10, wherein the widths of said array vary as a
20 function of the change of the viscosity of a fluid to be introduced into said array.

21 13. (Currently Amended) A stacked plate reactor for reacting one chemical reactant with at least
22 one other chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of
23 simple plates, stacked in layers, each simple plate having at least one opening that extends therethrough, an
24 opening in each simple plate overlapping at least one other opening in an adjacent simple plate, thereby
25 forming:

- 26 (a) a fluid path for each different chemical reactant;
- 27 (b) a processing volume in fluid communication with each fluid path for each different
28 chemical reactant;
- 29 (c) a fluid path for a chemical product in fluid communication with the processing
30 volume;
- (d) a fluid path for a heat transfer medium;
- (e) a heat exchanger in fluid communication with the fluid path for the heat transfer
medium and disposed so as to moderate a temperature of at least one of a chemical reactant, the processing
volume, and the fluid path for the chemical product; and
- (f) ~~a means for enhancing at least one of:~~

1 (i) a quantity of chemical product that is produced by said stacked plate reactor
2 per unit time; and

3 (ii) a quality of a chemical product that is produced by said stacked plate reactor
4 a plurality of serially connected reaction units providing internal parallelization
5 of fluid flow through the stacked plate reactor, thereby increasing a quantity of chemical product that
6 can be produced by said stacked plate reactor per unit time, each reaction unit including:

7 (i) a processing volume;

8 (ii) a reactant fluid path for each reactant, each reactant fluid path being in
9 fluid communication with a processing volume; and

10 (iii) a bypass fluid path for each reactant in fluid communication with any
11 subsequent reaction unit, but not in fluid communication with the processing volume of a current reaction
12 unit.

13 14. (Original) The stacked plate reactor of Claim 13, further comprising at least one additional
14 plate having no openings, said at least one additional plate being disposed to seal at least one of a top, a
15 bottom, and a side of the stacked plate reactor.

16 15. (Original) The stacked plate reactor of Claim 13, wherein said simple plates comprise a
17 material selected from the group consisting of crystalline wafers, ceramics, glasses, polymers, composite
18 materials, and metals.

19 16. (Original) The stacked plate reactor of Claim 13, wherein said simple plates are fabricated from
20 a stainless steel.

21 17. (Currently Cancelled)

22 18. (Currently Cancelled)

23 19. (Currently Amended) The stacked plate reactor of ~~Claim 18~~ Claim 13, wherein each
24 serially-connected reaction unit comprises:

25 (a) a first heat exchanger for modifying a temperature of a first chemical reactant; and

26 (b) a second heat exchanger for modifying a temperature of at least one of a second
27 chemical reactant and of the processing volume.

28 20. (Original) The stacked plate reactor of Claim 19, wherein a heat exchanger is shared between
29 adjacent serially-connected reaction units.

30 21. (Currently Amended) The stacked plate reactor of ~~Claim 18~~ Claim 13, wherein the processing
volume of each reaction unit is sandwiched between a pair of heat exchangers.

22. (Currently Amended) The stacked plate reactor of ~~Claim 18~~ Claim 13, wherein a plurality of
individual reaction units are irreversibly joined together to form a reactor stack.

23. (Currently Amended) The stacked plate reactor of ~~Claim 22~~ Claim 13, wherein a plurality of
individual reactor stacks are reversibly joined together to form a chemical plant.

1 24. (Currently Amended) The stacked plate reactor of ~~Claim 18~~ Claim 13, wherein each
2 subsequent serially-connected reaction unit is coupled to a subsequent reaction unit such that a first
3 simple plate in a subsequent reaction unit is stacked adjacent to a last simple plate of a preceding
4 reaction unit.

5 25. (Currently Amended) The stacked plate reactor of ~~Claim 18~~ Claim 13, wherein the processing
6 volume fluid paths for each reactant are disposed so that laminated flow is established between each reactant
7 flowing in the processing volume.

8 26. (Currently Amended) The stacked plate reactor of ~~Claim 18~~ Claim 13, wherein each
9 subsequent serially-connected reaction unit is coupled to a subsequent reaction unit such that a first
10 simple plate of a subsequent reaction unit also represents the last simple plate of a preceding reaction
11 unit.

12 27. (Currently Amended) The stacked plate reactor of ~~Claim 18~~ Claim 13, wherein the processing
13 volume fluid paths for each reactant are disposed so that laminated flow is established between each reactant
14 flowing in the processing volume.

15 28. (Currently Amended) The stacked plate reactor of ~~Claim 18~~ Claim 13, wherein the processing
16 volume comprises a plurality of individual mixing and reaction chambers.

17 29. (Currently Cancelled)

18 30. (Currently Cancelled)

19 31. (Currently Amended) The stacked plate reactor of Claim 13, ~~wherein said means for enhancing~~
20 ~~comprises~~ further comprising a plurality of fluid channels in the heat exchanger that extend substantially
21 orthogonal to a plurality of fluid channels for directing a flow of at least one of a chemical reactant and a
22 chemical product, where a temperature of said one of the chemical product and the chemical reactant is
23 modified by heat transfer relative to the heat transfer medium that is flowing through the heat exchanger,
24 thereby enhancing the quality of a product that is produced in the stacked plate reactor.

25 32. (Currently Amended) The stacked plate reactor of Claim 13, ~~wherein said means for enhancing~~
26 ~~comprises~~ further comprising fluid paths for each chemical reactant that is disposed so as to establish
27 laminated flow in the processing volume, thereby enhancing the quality of the product that is produced in
28 the stacked plate reactor.

29 33. (Currently Amended) The stacked plate reactor of Claim 13, ~~wherein said means for enhancing~~
30 ~~comprises~~ further comprising a processing volume simple plate disposed immediately adjacent to a simple
plate having an opening defining the processing volume, said processing volume simple plate having a first
opening associated with a first fluid path for a first chemical reagent, and a second opening associated with a
second fluid path for a second chemical reagent, said first opening and said second opening being aligned
with the opening defining the processing volume, such that a first reactant is caused to enter the processing
volume, followed by a second reactant in a manner that establishes laminated flow of the first reactant and

1 the second reactant in the processing volume, thereby enhancing the quality of a product that is produced in
2 the stacked plate reactor.

3 34. (Currently Amended) The stacked plate reactor of Claim 13, ~~wherein said means for enhancing~~
4 ~~comprises~~ further comprising means for equalizing a residence time distribution of a fluid flowing within
5 said reactor.

6 35. (Original) The stacked plate reactor of Claim 34, wherein said means for equalizing a residence
7 time distribution within said reactor comprises an opening in at least one simple plate, said opening having a
8 bifurcated shape, the bifurcated shape causing a fluid to split into a bifurcated fluid channel having a
9 plurality of branches.

10 36. (Original) The stacked plate reactor of Claim 35, wherein each chemical reactant flows through
11 a different bifurcated fluid channel, a stem of each bifurcated fluid channel being in fluid communication
12 with a respective chemical reactant inlet, and the branches of each bifurcated fluid channel being in fluid
13 communication with the processing volume.

14 37. (Original) The stacked plate reactor of Claim 35, wherein the processing volume comprises a
15 plurality of mixing and reaction chambers, such that one branch from each of the bifurcated fluid channels is
16 in fluid communication with each of the plurality of mixing and reaction chambers.

17 38. (Original) The stacked plate reactor of Claim 37, wherein the processing volume comprises a
18 plurality of mixing and reaction chambers, further comprising a bifurcated product collection channel
19 having a plurality of branches, a stem of the bifurcated product collection channel being in fluid
20 communication with a chemical product outlet, and each branch of the bifurcated product collection channel
21 being in fluid communication with a different one of the plurality of mixing and reaction chambers.

22 39. (Original) The stacked plate reactor of Claim 37, wherein a bifurcated fluid channel is included
23 for each chemical reactant and a bifurcated product collection channel is included to collect a product.

24 40. (Original) The stacked plate reactor of Claim 37, wherein the heat exchanger comprises a first
25 heat exchanger for modifying a temperature of a first chemical reactant, further comprising:

26 (a) a second heat exchanger for modifying a temperature of at least one of a second
27 chemical reactants and the processing volume;

28 (b) a third heat exchanger for modifying a temperature of at least one of the processing
29 volumes and a product collection channel; and

30 (c) a fourth heat exchanger for modifying a temperature of the product collection
channel.

41. (Original) The stacked plate reactor of Claim 34, wherein said means for equalizing a residence
time distribution within said reactor comprises a bifurcated fluid path having a plurality of branches.

1 42. (Original) The stacked plate reactor of Claim 41, wherein said bifurcated fluid path is achieved
2 by a bifurcated shaped opening in at least one simple plate, such that the bifurcated fluid path is oriented
3 substantially parallel to an orientation of the simple plates.

4 43. (Original) The stacked plate reactor of Claim 41, wherein said bifurcated fluid path is achieved
5 by aligning openings in a plurality of adjacent simple plates, such that the bifurcated fluid path is oriented
6 substantially orthogonally to an orientation of the simple plates.

7 44. (Original) The stacked plate reactor of Claim 41, wherein said bifurcated fluid path is achieved
8 by a combination of a bifurcated shaped opening in at least one simple plate, and by aligning openings in a
9 plurality of adjacent simple plates.

10 45. (Original) The stacked plate reactor of Claim 37, further comprising:

11 (a) a first outer simple plate having openings defining a fluid inlet for each different
12 chemical reactant, a fluid inlet for the heat transfer medium, and a fluid outlet for the heat transfer medium;
13 and

14 (b) a second outer simple plate having an opening defining the chemical product outlet.

15 46. (Original) The stacked plate reactor of Claim 37, wherein the processing volume comprises a
16 plurality of parallel mixing and reaction chambers that are disposed between a pair of heat exchangers.

17 47. (Original) The stacked plate reactor of Claim 34, wherein said means for equalizing a residence
18 time distribution of a fluid comprises a plurality of openings having different widths disposed in at least one
19 simple plate, the different widths being selected to provide a substantially even flow equipartition for a fluid
20 flowing through a plurality of different width fluid channels defined by the plurality of openings having
21 different widths.

22 48. (Currently Amended) The stacked plate reactor of ~~Claim 47~~ Claim 117, wherein each of the
23 plurality of openings having different widths are disposed in a parallel array, said openings being ordered so
24 as to decrease in size from a widest opening to a narrowest opening and defining a parallel array of the
25 different width fluid channels.

26 49. (Original) The stacked plate reactor of Claim 48, wherein a widest fluid channel in said
27 parallel array of different width fluid channels is disposed closer to a fluid inlet opening than any
28 other fluid channel in said parallel array.

29 50. (Original) The stacked plate reactor of Claim 48, wherein a widest fluid channel in said
30 parallel array of different width fluid channels is disposed further to a fluid outlet opening than any
other fluid channel in said parallel array.

 51. (Original) The stacked plate reactor of Claim 48, wherein each chemical reactant is directed
into a different parallel array of different width fluid channels.

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1 52. (Original) The stacked plate reactor of Claim 48, wherein the processing volume comprises a
2 parallel array of different width fluid channels, each different width fluid channel comprising an individual
3 mixing and reaction chamber.

4 53. (Original) The stacked plate reactor of Claim 48, wherein the widths of said fluid
5 channels in the array are determined as a function of the viscosity change of a fluid to be introduced
6 into said array.

7 54. (Original) The stacked plate reactor of Claim 48, wherein the heat exchanger comprises a
8 first heat exchanger for modifying a temperature of a first chemical reactant, and a second heat
9 exchanger for modifying a temperature of at least one of a second chemical reactant and the
10 processing volume.

11 55. (Original) The stacked plate reactor of Claim 48, further comprising one of a top simple plate, a
12 bottom simple plate, and a side simple plate, said one having openings defining a fluid inlet for each
13 different chemical reactant, a fluid inlet for the heat transfer medium, a fluid outlet for the heat transfer
14 medium, and a chemical product outlet.

15 56. (Currently Amended) The stacked plate reactor of Claim 13, ~~wherein said means for enhancing~~
16 ~~comprises~~ further comprising a plurality of elongate openings in a simple plate that define the heat
17 exchanger, the simple plate being no thicker than about two millimeters, thereby enhancing an efficiency
18 with which the heat exchanger functions to increase a quality of a product produced in said reactor.

19 57. (Original) The stacked plate reactor of Claim 13, further comprising at least one plug having a
20 size and shape corresponding to a non-required fluid path defined by aligned openings in said plurality of
21 simple plates, said at least one plug sealing the aligned openings defining said non-required fluid path,
22 thereby eliminating a dead volume in said stacked plate reactor.

23 58. (Original) The stacked plate reactor of Claim 13, wherein the stack of simple plates are
24 removably held together with an applied compressive force.

25 59. (Original) The stacked plate reactor of Claim 13, further comprising a housing that applies a
26 compressive force against a top simple plate and a bottom simple plate.

27 60. (Original) The stacked plate reactor of Claim 13, wherein a mean surface roughness of the
28 simple plates is less than about two micrometers, and the simple plates are substantially free of scratches.

29 61. (Original) The stacked plate reactor of Claim 13, wherein the simple plates are held together
30 with an applied compressive force, developing a pressure of at least about 300 Newtons per square
millimeter.

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1 62. (Original) A simple plate chemical reactor for processing at least two reactants to form a
2 desired chemical product, comprising:

3 (a) a first outer simple plate comprising a fluid inlet for each different chemical
4 reactant, a fluid outlet for a chemical product, a fluid inlet for a heat transfer medium, and a fluid outlet for a
5 heat transfer medium;

6 (b) a plurality of internal simple plates defining a plurality of serially-connected reaction
7 units, each reaction unit being in fluid communication with said first outer simple plate, each reaction unit
8 comprising a stack of simple plates, stacked in layers, each simple plate having at least one opening that
9 extends therethrough, an opening in each simple plate overlapping at least one other opening in an adjacent
10 simple plate, thereby forming:

11 (i) a plurality of heat exchangers for modifying a temperature of at least one of
12 a chemical reactant and a chemical product;

13 (ii) at least one mixing and reaction chamber; and

14 (iii) a bypass fluid path for each reactant, such that a portion of each reactant is
15 diverted from the at least one mixing and reaction chamber of a present reaction unit, and is thus available to
16 be directed to at least one mixing and reaction chamber of a subsequent reaction unit; and

17 (c) a second outer plate disposed such that the plurality of internal simple plates are
18 stacked between the first outer, simple plate and the second outer plate.

19 63. (Original) A simple plate chemical reactor for processing at least two reactants to form a
20 desired chemical product, comprising:

21 (a) a first outer simple plate comprising a fluid inlet for each different chemical
22 reactant, a fluid outlet for a chemical product, a fluid inlet for a heat transfer medium, and a fluid outlet for a
23 heat transfer medium;

24 (b) a plurality of internal simple plates defining a plurality of serially-connected reaction
25 units, each reaction unit being in fluid communication with said first simple plate, each reaction unit
26 comprising a stack of simple plates, stacked in layers, each simple plate having at least one opening that
27 extends therethrough, an opening in each simple plate overlapping at least one other opening in an adjacent
28 simple plate, thereby forming:

29 (i) a plurality of heat exchangers for modifying a temperature of at least one of
30 a chemical reactant and a chemical product;

 (ii) a processing volume;

 (iii) a processing fluid path for each reactant, each processing fluid path being in
fluid communication with a corresponding reactant fluid inlet and the processing volume;

 (iv) a product collection fluid path in fluid communication with the product
outlet and the processing volume;

1 (v) a reactant bypass fluid path for each reactant, each reactant bypass fluid
2 path bypassing the processing volume of a present reaction unit, and being in fluid communication
3 with a different reaction unit; and

4 (vi) a product bypass fluid path for the reaction product, each product
5 bypass fluid path bypassing the processing volume of a present reaction unit, and being in fluid
6 communication with a different reaction unit; and

7 (c) a second outer plate disposed such that the plurality of internal simple plates are
8 stacked between the first outer simple plate and the second outer plate.

9 64. (Original) The chemical reactor of Claim 63, wherein the simple plates having different
10 configurations are stacked to fabricate the reactor.

11 65. (Original) The chemical reactor of Claim 63, wherein said second outer plate and said first
12 outer simple plate are identical in configuration, further comprising a plurality of plugs to seal each opening
13 in said second outer plate.

14 66. (Original) The chemical reactor of Claim 65, further comprising a second simple plate disposed
15 between said first outer simple plate and a first reaction unit, said second simple plate having an opening
16 associated with a product fluid passage.

17 67. (Original) The stacked plate reactor of Claim 63, further comprising means for enhancing a
18 fluid distribution within said reactor.

19 68. (Original) The chemical reactor of Claim 67, wherein said means for enhancing the fluid
20 distribution within the reactor comprises an opening having a bifurcated shape formed in at least one simple
21 plate, for distributing a fluid into a bifurcated channel having a plurality of branches.

22 69. (Original) The chemical reactor of Claim 68, further comprising a bifurcated fluid channel for
23 each chemical reactant, a stem of each bifurcated fluid channel being in fluid communication with a
24 respective chemical reactant inlet, and branches of each bifurcated fluid channel being in fluid
25 communication with the processing volume.

26 70. (Original) The chemical reactor of Claim 68, further comprising a bifurcated product collection
27 channel having a plurality of branches, a stem of the bifurcated product collection channel being in fluid
28 communication with the chemical product outlet, and branches of said bifurcated product collection channel
29 being in fluid communication with the processing volume.

30 71. (Original) The chemical reactor of Claim 68, wherein each reaction unit includes a bifurcated
fluid channel and a bifurcated product collection channel.

72. (Original) The chemical reactor of Claim 67, wherein said means for enhancing a fluid
distribution within the reactor comprises at least one simple plate in which a plurality of openings having
different widths are formed, said different widths being selected to provide a substantially even flow

1 equipartition for a fluid flowing in a plurality of different width fluid channels defined by said plurality of
2 openings.

3 73. (Original) The chemical reactor of Claim 72, wherein each of the plurality of openings having
4 different widths are disposed in a parallel array, ordered in increasing widths from a narrowest opening to a
5 widest opening, thereby defining a parallel array of different width fluid channels.

6 74. (Original) The chemical reactor of Claim 73, wherein an incremental increase in the widths of
7 the fluid channels of said array is a function of the viscosity change of a fluid that will flow through the
8 different width fluid channels of said array, so as to equalize a residence time distribution of the fluid within
9 said array.

10 75. (Original) The chemical reactor of Claim 67, wherein said means for enhancing a fluid
11 distribution within the reactor comprises at least one simple plate in which a plurality of openings having
12 different lengths are formed, said different lengths being selected to provide a substantially equivalent even
13 flow equipartition for a fluid flowing in a plurality of different width fluid channels defined by said plurality
14 of openings.

15 76. (Currently Amended) A simple plate chemical reactor for processing at least two reactants to
16 form a desired chemical product, comprising:

17 (a) a first outer simple plate and a second outer simple plate, said first and second outer
18 plates together including a fluid inlet for each chemical reactant, a product outlet, a fluid inlet for a heat
19 transfer medium, and a fluid outlet for the heat transfer medium;

20 (b) a plurality of simple plates disposed between the first and the second outer simple
21 plates, each simple plate having at least one opening that extends therethrough, an opening in each simple
22 plate overlapping at least one other opening in an adjacent simple plate, thereby forming:

23 (i) a plurality of heat exchangers for modifying a temperature of at least one of
24 a chemical reactant and a chemical product;

25 (ii) at least one fluid path for each chemical reactant;

26 (iii) at least one mixing and reaction channel; and

27 (iv) ~~means for manipulating a flow of fluid in said stacked plate reactor to~~
28 ~~achieve a desired result~~ at least one of:

29 (1) at least one bifurcated fluid channel configured to enhance a
30 fluid distribution within the reactor;

(2) a plurality of openings having different widths formed in at
least one simple plate, said different widths having been selected to provide a substantially even flow
equipartition for a fluid flowing in a plurality of fluid channels defined by the plurality of openings
having different widths; and

1 (3) a plurality of openings having different lengths formed in at
2 least one simple plate, said different lengths having been selected to provide a substantially even flow
3 equipartition for a fluid flowing in a plurality of fluid channels defined by the plurality of openings
4 having different lengths.

5 77. (Original) The simple plate chemical reactor of Claim 76, wherein the product outlet is
6 disposed in said first outer simple plate.

7 78. (Original) The simple plate chemical reactor of Claim 76, wherein the product outlet is
8 disposed in said second outer plate.

9 79. (Currently Amended) The simple plate chemical reactor of Claim 76, ~~wherein said means for~~
10 ~~manipulating a flow of fluid in said stacked plate reactor to achieve a desired result comprise~~ further
11 comprising a plurality of openings in a simple plate defining a heat exchanger, and a plurality of openings in
12 an adjacent simple plate defining at least one of a fluid path for a chemical reactant and a mixing and
13 reaction channel, such that the plurality of openings in the simple plate defining the heat exchanger are
14 substantially orthogonal to the plurality of openings in said adjacent simple plate.

15 80. (Currently Amended) The simple plate chemical reactor of Claim 76, ~~wherein said means for~~
16 ~~manipulating a flow of fluid in said stacked plate reactor to achieve a desired result comprises~~ further
17 comprising means for enabling diffusion mixing to occur between at least a first reactant and a second
18 reactant within the simple plate chemical reactor.

19 81. (Original) The simple plate chemical reactor of Claim 80, wherein said means for enabling
20 diffusion mixing to occur comprises an upper reaction channel simple plate disposed adjacent to a simple
21 plate having an opening defining a mixing and reaction channel, said upper reaction channel simple plate
22 having a first opening associated with a first fluid path for a first chemical reagent, and a second opening
23 associated with a second fluid path for a second chemical reagent, said first opening and said second
24 opening being aligned with the opening defining a mixing and reaction channel, such that a first reactant is
25 caused to enter the mixing and reaction channel first, followed by a second reactant, establishing laminated
26 flow between the first reactant and the second reactant in the mixing and reactant channel.

27 82. (Currently Cancelled)

28 83. (Currently Amended) The simple plate chemical reactor of ~~Claim 82~~ Claim 76, wherein said
29 ~~means for enhancing a fluid distribution within the reactor~~ the at least one bifurcated fluid channel
30 ~~comprises an opening in at least one simple plate, said opening having a bifurcated shape for a fluid flowing~~
~~in at least one bifurcated fluid channel defined by the opening having said bifurcated shape.~~

 84. (Currently Amended) The simple plate chemical reactor of Claim 83, wherein ~~a bifurcated~~
~~fluid channel~~ the at least one bifurcated fluid channel comprises a different bifurcated fluid channel for each
chemical reactant, each different bifurcated fluid channel having a stem and a plurality of branches is
included for each chemical reactant, the stem of each bifurcated fluid channel being in fluid communication

1 with a respective chemical reactant inlet, and branches of each bifurcated fluid channel being in fluid
2 communication with a mixing and reaction channel.

3 85. (Original) The simple plate chemical reactor of Claim 83, wherein the at least one bifurcated
4 fluid channel comprises a bifurcated product collection channel, the stem of the bifurcated product
5 collection channel being in fluid communication with the product outlet, and the branches of said bifurcated
6 product collection channel being in fluid communication with a mixing and reaction channel.

7 86. (Original) The simple plate chemical reactor of Claim 83, wherein a bifurcated fluid channel is
8 included for each chemical reactant and one bifurcated fluid channel comprises a bifurcated product
9 collection channel.

10 87. (Original) The simple plate chemical reactor of Claim 83, wherein said plurality of heat
11 exchangers comprise:

- 12 (a) a first heat exchanger for modifying a temperature of a first chemical reactant;
- 13 (b) a second heat exchanger for modifying a temperature of at least one of a second
14 chemical reactant and a mixing and reaction channel;
- 15 (c) a third heat exchanger for modifying a temperature of at least one of said mixing
16 and reaction channel and a product collection channel; and
- 17 (d) a fourth heat exchanger for modifying a temperature of said product collection
18 channel.

19 88. (Currently Cancelled)

20 89. (Currently Amended) The simple plate chemical reactor of ~~Claim 88~~ Claim 76, wherein each
21 of the plurality of openings having different widths in a single simple plate comprise a parallel array,
22 ordered from a narrowest opening, incrementally increasing to a widest opening, defining a parallel array of
23 the plurality of fluid channels having different widths.

24 90. (Original) The simple plate chemical reactor of Claim 89, wherein a widest fluid channel in
25 said parallel array of fluid channels is disposed further to a fluid outlet opening than any other fluid channel
26 in said parallel array.

27 91. (Original) The simple plate chemical reactor of Claim 90, wherein each chemical reactant is
28 directed into a different parallel array of fluid channels having different widths, each different parallel array
29 of fluid channels being disposed in a different simple plate.

30 92. (Original) The simple plate chemical reactor of Claim 90, wherein the parallel array of fluid
channels having different widths comprises a mixing and reaction channel.

93. (Currently Cancelled)

94. (Currently Amended) The simple plate chemical reactor of Claim 76, ~~wherein said means for
manipulating a flow of fluid in said simple plate chemical reactor to achieve a desired result comprises~~

1 further comprising means for providing internal parallelization of said simple plate chemical reactor, to
2 achieve increased throughput.

3 95. (Original) The simple plate chemical reactor of Claim 94, wherein contiguous sets of the
4 simple plates comprise a plurality of serially-connected reaction units, and wherein said means for providing
5 internal parallelization comprise a plurality of openings in different contiguous sets of the simple plates,
6 which when aligned form, for each one of said serially-connected reaction units:

7 (a) a reaction unit fluid path in fluid communication with processing volumes in that
8 reaction unit; and

9 (b) a bypass fluid path that bypasses all processing volumes in that reaction unit, and is
10 in fluid communication with any subsequent reaction unit.

11 96. (Original) The simple plate chemical reactor of Claim 95, wherein each serially-connected
12 reaction unit comprises:

13 (a) a first heat exchanger for modifying a temperature of a first chemical reactant;

14 (b) a second heat exchanger for modifying a temperature of at least one of a second
15 chemical reactant and a mixing and reaction channel, said mixing and reaction channel being operative to:

16 (i) establish a laminated flow between a first chemical reactant and a second
17 chemical reactant;

18 (ii) mix the first chemical reactant and the second chemical reactant together via
19 diffusion mixing; and

20 (iii) provide sufficient residence time for initiating a chemical reaction between
21 the first chemical reactant and the second chemical reactant; and

22 (c) a third heat exchanger for modifying a temperature of said mixing and reaction
23 channel.

24 97. (Original) The simple plate chemical reactor of Claim 96, wherein the first heat exchanger of
25 each serially-connected reaction unit disposed downstream of a different serially-connected reaction unit
26 also comprises the third heat exchanger of the reaction unit disposed immediately upstream.

27 98. (Original) The simple plate chemical reactor of Claim 95, wherein a plurality of said
28 serially-connected reaction units are irreversibly joined together to form a reactor stack.

29 99. (Original) The simple plate chemical reactor of Claim 98 wherein a plurality of individual
30 reactor stacks are reversibly joined together to form a chemical plant.

100. (Currently Cancelled)

101. (Currently Cancelled)

102. (Currently Cancelled)

103. (Currently Cancelled)

104. (Currently Cancelled)

1 105. (Currently Cancelled)

2 106. (Currently Cancelled)

3 107. (Currently Cancelled)

4 108. (Currently Cancelled)

5 109. (Currently Cancelled)

6 110. (Currently Cancelled)

7 Please add new Claims 111-123 as follows:

8 111. (New) A stacked plate reactor for reacting one chemical reactant with at least one other
9 chemical reactant to form a chemical product, said stacked plate reactor comprising:

10 (a) a plurality of simple plates, stacked in layers, each simple plate having a
11 plurality of openings that extend therethrough, such that when the plurality of simple plates are
12 stacked in layers to achieve the stacked plate reactor, openings in each simple plate overlap openings in an
13 adjacent simple plate, thereby forming:

14 (i) a fluid path for each different chemical reactant;
15 (ii) a fluid path for a chemical product;
16 (iii) a fluid path for a heat transfer medium;
17 (iv) a heat exchanger coupled in fluid communication with the fluid path for
18 the heat transfer medium; and

19 (v) means for manipulating a flow of fluid in said stacked plate reactor to
20 achieve a desired result; and

21 (b) at least one additional plate having no openings, said at least one additional
22 plate being disposed to seal at least one of a top, a bottom, and a side of the stacked plate reactor.

23 112. (New) A stacked plate reactor for reacting one chemical reactant with at least one other
24 chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of simple
25 plates, stacked in layers, each simple plate having a plurality of openings that extend therethrough,
26 such that when the plurality of simple plates are stacked in layers to achieve the stacked plate reactor,
27 openings in each simple plate overlap openings in an adjacent simple plate, thereby defining:

28 (a) a fluid path for each different chemical reactant;
29 (b) a fluid path for a chemical product;
30 (c) a fluid path for a heat transfer medium;
(d) a heat exchanger coupled in fluid communication with the fluid path for the heat
transfer medium; and

(e) means for providing internal parallelization of fluid flow through the stacked plate
reactor, thereby increasing a quantity of chemical product that can be produced by said stacked plate reactor

per unit time, such internal parallelization being characterized by achieving at least two parallel fluid flows in different layers of the stacked plate reactor that are not in fluid communication with each other.

113. (New) A stacked plate reactor for reacting one chemical reactant with at least one other chemical reactant to form a chemical product, said stacked plate reactor comprising:

(a) a plurality of simple plates, stacked in layers, each simple plate having a plurality of openings that extend therethrough, such that when the plurality of simple plates are stacked in layers to achieve the stacked plate reactor, openings in each simple plate overlap openings in an adjacent simple plate, thereby forming:

(i) a fluid path for each different chemical reactant;
(ii) a processing volume in fluid communication with each fluid path for each different chemical reactant;

(iii) a fluid path for a chemical product in fluid communication with the processing volume;

(iv) a fluid path for a heat transfer medium;
(v) a heat exchanger in fluid communication with the fluid path for the heat transfer medium and disposed so as to moderate a temperature of at least one of a chemical reactant, the processing volume, and the fluid path for the chemical product; and

(vi) means for enhancing at least one of:
(1) a quantity of chemical product that is produced by said stacked plate reactor per unit time; and

(2) a quality of a chemical product that is produced by said stacked plate reactor, wherein a relatively higher quality product is characterized by at least one of a relatively higher yield and the presence of relatively fewer byproducts, and a relatively lower quality product is characterized by at least one of a relatively lower yield and relatively more byproducts; and

(b) at least one additional plate having no openings, said at least one additional plate being disposed to seal at least one of a top, a bottom, and a side of the stacked plate reactor.

114. (New) A stacked plate reactor for reacting one chemical reactant with at least one other chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of simple plates, stacked in layers, each simple plate having a plurality of openings that extend therethrough, such that when the plurality of simple plates are stacked in layers to achieve the stacked plate reactor, openings in each simple plate overlap openings in an adjacent simple plate, thereby defining:

(a) a fluid path for each different chemical reactant;
(b) a processing volume in fluid communication with each fluid path for each different chemical reactant;

1 (c) a fluid path for a chemical product in fluid communication with the processing
2 volume;
3 (d) a fluid path for a heat transfer medium; and
4 (e) a heat exchanger in fluid communication with the fluid path for the heat transfer
5 medium and disposed so as to moderate a temperature of at least one of a chemical reactant, the processing
6 volume, and the fluid path for the chemical product, the heat exchanger comprising a plurality of heat
7 exchanger fluid channels that extend substantially orthogonal to a plurality of fluid channels for directing a
8 flow of at least one of a chemical reactant and a chemical product, such that the plurality of heat exchanger
9 fluid channels are not in fluid communication with the plurality of fluid channels for directing a flow of at
10 least one of the chemical reactant and the chemical product, and where a temperature of said one of the
11 chemical product and the chemical reactant is modified by heat transfer relative to the heat transfer medium
12 that is flowing through the heat exchanger, thereby enhancing a quality of a product that is produced in the
13 stacked plate reactor.

14 115. (New) A stacked plate reactor for reacting one chemical reactant with at least one other
15 chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of simple
16 plates, stacked in layers, each simple plate having a plurality of openings that extend therethrough,
17 such that when the plurality of simple plates are stacked in layers to achieve the stacked plate reactor,
18 openings in each simple plate overlap openings in an adjacent simple plate, thereby forming:

19 (a) a fluid path for each different chemical reactant;
20 (b) a first reaction unit defined by a plurality of openings in the simple plates, said
21 plurality of openings being aligned to form, for each different chemical reactant:

22 (i) a reaction unit fluid path in fluid communication with a processing volume
23 in said first reaction unit; and

24 (ii) a bypass fluid path that bypasses the processing volume in the first reaction
25 unit and is in fluid communication with any subsequent reaction unit; and

26 (c) a last reaction unit defined by the plurality of openings in the simple plate, said
27 plurality of openings being aligned to form, for each different chemical reactant, a reaction unit fluid path in
28 fluid communication with a processing volume in said last reaction unit;

29 (d) a fluid path for a chemical product in fluid communication with each processing
30 volume;

(e) a fluid path for a heat transfer medium; and

(f) a heat exchanger in fluid communication with the fluid path for the heat transfer
medium and disposed so as to moderate a temperature of at least one of a chemical reactant, at least one
processing volume, and the fluid path for the chemical product.

1 116. (New) A stacked plate reactor for reacting one chemical reactant with at least one other
2 chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of simple
3 plates, stacked in layers, each simple plate having a plurality of openings that extend therethrough,
4 such that when the plurality of simple plates are stacked in layers to achieve the stacked plate reactor,
5 openings in each simple plate overlap openings in an adjacent simple plate, thereby defining:

- 6 (a) a single fluid inlet for each chemical reactant;
- 7 (b) a reactor fluid path for each chemical reactant, each reactor fluid path being in fluid
8 communication with a processing volume in a first reaction unit;
- 9 (c) a bypass fluid path for each chemical reactant, each bypass fluid path
10 bypassing the processing volume in the first reaction unit, and being in fluid communication with any
11 subsequent reaction unit; and
- 12 (d) a single fluid outlet for the chemical product.

13 117. (New) A stacked plate reactor for reacting one chemical reactant with at least one other
14 chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of simple
15 plates, stacked in layers, each simple plate having a plurality of openings that extend therethrough,
16 such that when the plurality of simple plates are stacked in layers to achieve the stacked plate reactor,
17 openings in each simple plate overlap openings in an adjacent simple plate, thereby forming:

- 18 (a) a fluid path for each different chemical reactant;
- 19 (b) a processing volume in fluid communication with each fluid path for each different
20 chemical reactant;
- 21 (c) a fluid path for a chemical product in fluid communication with the processing
22 volume;
- 23 (d) a plurality of openings having different widths disposed in at least one simple plate,
24 the different widths being selected to provide a substantially even flow equipartition for a fluid flowing
25 through a plurality of different width fluid channels defined by the plurality of openings having different
26 widths;
- 27 (e) a fluid path for a heat transfer medium; and
- 28 (f) a heat exchanger in fluid communication with the fluid path for the heat transfer
29 medium and disposed so as to moderate a temperature of at least one of a chemical reactant, at least one
30 processing volume, and the fluid path for the chemical product.

118. (New) A simple plate chemical reactor for processing at least two reactants to form a desired
chemical product, comprising:

- (a) a first outer simple plate and a second outer simple plate, said first and second outer
simple plates together including a fluid inlet for each chemical reactant, a product outlet, a fluid inlet for a
heat transfer medium, and a fluid outlet for the heat transfer medium; and

1 (b) a plurality of simple plates disposed between the first and the second outer simple
2 plates, each simple plate having a plurality of openings that extend therethrough, such that when the
3 plurality of simple plates are stacked in layers, openings in each simple plate overlap openings in an
4 adjacent simple plate, thereby forming:

5 (i) a plurality of heat exchangers for modifying a temperature of at least one of
6 a chemical reactant and a chemical product;

7 (ii) at least one fluid path for each chemical reactant;

8 (iii) at least one mixing and reaction channel; and

9 (iv) at least one bifurcated fluid channel configured to enhance a fluid
10 distribution within the reactor.

11 119. (New) A simple plate chemical reactor for processing at least two reactants to form a desired
12 chemical product, comprising:

13 (a) a first outer simple plate and a second outer simple plate, said first and second outer
14 simple plates together including a fluid inlet for each chemical reactant, a product outlet, a fluid inlet for a
15 heat transfer medium, and a fluid outlet for the heat transfer medium; and

16 (b) a plurality of simple plates disposed between the first and the second outer simple
17 plates, each simple plate having a plurality of openings that extend therethrough, such that when the
18 plurality of simple plates are stacked in layers, openings in each simple plate overlap openings in an
19 adjacent simple plate, thereby forming:

20 (i) a plurality of heat exchangers for modifying a temperature of at least
21 one of a chemical reactant and a chemical product;

22 (ii) at least one fluid path for each chemical reactant;

23 (iii) at least one mixing and reaction channel; and

24 (iv) a plurality of openings having different widths formed in at least one
25 simple plate, said different widths having been selected to provide a substantially even flow
26 equipartition for a fluid flowing in a plurality of fluid channels defined by the plurality of openings
27 having different widths.

28 120. (New) A simple plate chemical reactor for processing at least two reactants to form a desired
29 chemical product, comprising:

30 (a) a first outer simple plate and a second outer simple plate, said first and second outer
simple plates together including a fluid inlet for each chemical reactant, a product outlet, a fluid inlet for a
heat transfer medium, and a fluid outlet for the heat transfer medium; and

(b) a plurality of simple plates disposed between the first and the second outer simple
plates, each simple plate having a plurality of openings that extend therethrough, such that when the

1 plurality of simple plates are stacked in layers, openings in each simple plate overlap openings in an
2 adjacent simple plate, thereby forming:

- 3 (i) a plurality of heat exchangers for modifying a temperature of at least one of
4 a chemical reactant and a chemical product;
- 5 (ii) at least one fluid path for each chemical reactant;
- 6 (iii) at least one mixing and reaction channel; and
- 7 (iv) a plurality of openings having different lengths formed in at least one
8 simple plate, said different lengths having been selected to provide a substantially even flow
9 equipartition for a fluid flowing in a plurality of fluid channels defined by the plurality of openings
10 having different lengths.

11 121. (New) A stacked plate reactor for reacting one chemical reactant with at least one other
12 chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of simple
13 plates stacked in layers, each simple plate having a plurality of openings that extend therethrough,
14 openings in each simple plate overlapping openings in an adjacent simple plate, thereby forming:

- 15 (a) a fluid path for each different chemical reactant;
- 16 (b) a fluid path for a chemical product; and
- 17 (c) at least one of:
 - 18 (i) at least one bifurcated fluid channel configured to enhance a fluid
19 distribution within the reactor;
 - 20 (ii) a plurality of openings having different widths formed in at least one
21 simple plate, said different widths having been selected to provide a substantially even flow
22 equipartition for a fluid flowing in a plurality of fluid channels defined by the plurality of openings
23 having different widths;
 - 24 (iii) a plurality of openings having different lengths formed in at least one
25 simple plate, said different lengths having been selected to provide a substantially even flow
26 equipartition for a fluid flowing in a plurality of fluid channels defined by the plurality of openings
27 having different lengths; and
 - 28 (iv) a plurality of individual reaction units providing internal parallelization
29 of fluid flow through the stacked plate reactor, thereby increasing a quantity of chemical product that
30 can be produced by said stacked plate reactor per unit time, each reaction unit including:
 - (1) a mixing and reaction chamber;
 - (2) a reactant fluid path for each reactant, each reactant fluid path
being in fluid communication with said mixing and reaction chamber; and
 - (3) a bypass fluid path for each reactant, each bypass fluid path
being in fluid communication with a different individual reaction unit, such that a reactant flowing in

1 a bypass fluid path in a reaction unit does not also flow into a mixing and reaction chamber in said
2 reaction unit.

3 122. (New) A stacked plate reactor for reacting one chemical reactant with at least one other
4 chemical reactant to form a chemical product, said stacked plate reactor being assembled from a plurality of
5 plates stacked in layers, said stacked plate reactor comprising:

6 (a) a fluid path for each different chemical reactant;

7 (b) a fluid path for a chemical product; and

8 (c) at least one of:

9 (i) at least one bifurcated fluid channel configured to enhance a fluid
10 distribution within the reactor;

11 (ii) a plurality of openings having different widths formed in at least one
12 simple plate, said different widths having been selected to provide a substantially even flow
13 equipartition for a fluid flowing in a plurality of fluid channels defined by the plurality of openings
14 having different widths;

15 (iii) a plurality of openings having different lengths formed in at least one
16 simple plate, said different lengths having been selected to provide a substantially even flow
17 equipartition for a fluid flowing in a plurality of fluid channels defined by the plurality of openings
18 having different lengths; and

19 (iv) a plurality of individual reaction units providing internal parallelization
20 of fluid flow through the stacked plate reactor, thereby increasing a quantity of chemical product that
21 can be produced by said stacked plate reactor per unit time, each reaction unit including:

22 (1) a mixing and reaction chamber;

23 (2) a reactant fluid path for each reactant, each reactant fluid path
24 being in fluid communication with said mixing and reaction chamber; and

25 (3) a bypass fluid path for each reactant, each bypass fluid path
26 being in fluid communication with a different individual reaction unit, such that a reactant flowing in
27 a bypass fluid path in a reaction unit does not also flow into a mixing and reaction chamber in said
28 reaction unit.

29 123. (New) A stacked plate reactor for reacting one chemical reactant with at least one other
30 chemical reactant to form a chemical product, said stacked plate reactor comprising a plurality of simple
plates stacked in layers, each simple plate having a plurality of openings that extend therethrough,
openings in each simple plate overlapping openings in an adjacent simple plate, thereby forming:

(a) a fluid path for each different chemical reactant;

(b) a fluid path for a chemical product; and

1 (c) a heat transfer fluid path for a heat transfer medium, such that the heat transfer fluid
2 path and the fluid paths for each different chemical reactant and the chemical product are not in fluid
3 communication;

4 (d) a heat exchanger coupled in fluid communication with the fluid path for the
5 heat transfer medium; and

6 (e) means for manipulating a flow of fluid in said stacked plate reactor to achieve
7 a desired result.
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